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RESEARCH ARTICLE

Feasibility of Pickling from Common Bean (*Phaseolus vulgaris*)

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Abstract

Common bean (*Phaseolus vulgaris*) is often a main source of protein, dietary fiber and minerals in diet offering benefits for human health. With the purpose of accelerating the commercial value of this vegetable, objective of this study focused on the lactic acid fermentation of the common bean into pickle. Different technical parameters such as blanching time and temperature, calcium chloride concentration in soaking, salt sugar percentage submersion affecting to fermentation were examined. This research was conducted in 2019 in the Labone Scientific laboratory. Results showed that 95°C in 6 seconds were suitable for blanching of common bean. The optimal calcium chloride concentration for soaking was recorded at 0.2% for soaking of common bean. The optimal salt: sugar was noticed at 7.5%:2.5% adequately for pickling in 14 days. As a result from pickling process, common bean will get a longer shelf life, translucent appearance, firm texture and pickle flavor. Pickled common bean was ideal for promoting the positive health image of probiotics. The findings of this investigation help diversifying the multiuse of common bean in food processing enterprises.

Keywords: *Common bean, Phaseolus vulgaris, Pickling, Blanching, Soaking, Calcium chloride.*

Introduction

Common bean (Phaseolus vulgaris) is a significant source of protein, carbohydrates, vitamins and minerals. It's also rich in unsaturated fatty acids, such as linoleic and oleic acid [1]. Among the cultivated bean, the common bean is dominant with a vast growing area. As its high nutritional value, the bean is considered a staple grain to the diet for human consumption [2]. It has a lot of benefits in lowering cholesterol and triglycerides, and to combat constipation preventing colon cancer. It revealed low carbohydrate content that could be a good food choice for diabetics [3]. It offers as a valuable alternative source of protein and minerals in the local diet.

It contains anti-nutritional and flatulence factors, such as trypsin inhibitors and oligosaccharides. However, total phenolic compounds and antioxidant activity are high [4, 5]. This crop has a great economic importance, as it generates income for local farmers. Pickling is the oldest and useful method which is used for the preservation of food by anaerobic fermentation or immersion in the vinegar and resulting food is called pickle [6]. Salt and sugar enables a natural fermentation to occur by selecting for the lactic acid bacteria present on the cucumbers and inhibiting salt-sensitive spoilage bacteria [7]. Salt is an essential in food as it improves the preservative, technological and sensory quality of food [8]. Salt is one of the most commonly employed agents for food conservation, allowing considerable increase in storage time by reducing water activity [9]. As sugar convert to the lactic acid the condition become acidic and inhibits the growth of pathogens and other non acidic tolerant microorganisms' especially aerobic spoilage microorganisms [10].

Due to pickling process texture and flavour of pickled vegetables are changed and after pickling show firm texture, translucent appearance and longer shelf-life [11]. Pickles contain phytochemicals and minerals which come from ingredients, therefore pickles are useful against different diseases such as cancer, inflammation, brain dysfunction, atherosclerosis [6]. There was not any research mentioned to the production of pickled common bean.

Therefore, objective of this study focused on different technical parameters such as blanching time and temperature, calcium

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chloride concentration in soaking, salt: sugar percentage submersion during pickling.

Materials and Method

Material

Common beans were collected from Soc Trang province, Vietnam. They must be cultivated following Viet GAP without pesticide residue to ensure food safety. After collecting, they must be conveyed to laboratory within 8 hours for experiments. They were washed under tap water to remove foreign matters. Besides common bean, we also used other materials such as sodium chloride, calcium chloride, saccharose. Lab utensils and equipments included knife, weight balance, cooker, fermentator, biuret, micropippetor. This research was conducted in 2019 in the Labone Scientific laboratory.

Researching Procedure

Effect of Blanching Temperature and Time to titratable Acidity (g/L), Firmness (N) and sensory Characteristics of Pickled Common Bean

Common bean was blanched in hot water in different condition (100^{o}C in 4 seconds; 95^{o}C in 6 seconds; 90^{o}C in 8 seconds and 85^{o}C in 10 seconds). The blanched common bean would be fermented at ambient temperature in 6.5% salt: 5.5% sugar solution in 14 days. Total acidity (%), firmness (N), sensory score of pickled common bean would be analyzed to choose the appropriate blanching condition.

Effect of Calcium Chloride Concentration in Soaking to Titratable Acidity (g/L), Firmness (N) and Sensory Characteristics of Pickled Common Bean

Common bean was blanched at 95^{o}C in 6 seconds in hot water. After blanching, it was soaked in calcium chloride by different concentration (0.1%, 0.15%, 0.20%, 0.25%) in 4 hours. Then it would be washed with clean water and drain to drip excess water. It would be fermented at ambient temperature in a mixture of 6.5% salt: 3.5% sugar solution in 14 days. Total acidity (%), firmness (N), sensory score of pickled common bean would be analyzed to choose the appropriate calcium chloride concentration in soaking.

Effect of Salt: Sugar Ratio in Fermentation to titratable Acidity (g/L), Firmness (N), Total Phenolic Content (mg GAE/g) and Sensory Characteristics of Pickled Common Bean

Common bean were blanched at 95^{o}C in 6 seconds in hot water. The blanched common bean would be soaked in in calcium chloride by 0.2% in 4 hours. Then it would be washed with clean water and drain to drip excess water. It would be fermented at ambient temperature in a mixture of salt: sugar (6.5%:3.5%; 7.0%:3.0%, 7.5%:2.5%; 8.0%:2.0%) in 14 days. Total acidity (%), firmness (N), total phenolic content (mg GAE/g), sensory score of pickled common bean would be analyzed to choose the appropriate salt: sugar percentage in fermentation.

Physico-chemical, Sensory and Statistical Analysis

Titratable acidity (g/L) content was analyzed by tritration. Firmness (N) was estimated by penetrometer. Sensory score was evaluated by a group of panelist using 4 point-Hedonic scale. Total phenolic content (mg GAE/g) was measured using the Folin-Ciocalteu colorimetric method described previously [12].

The experiments were run in triplicate with three different lots of samples. Statistical analysis was performed by the Stat graphics Centurion XVI.

Result & Discussion

Effect of Blanching Temperature and Time to Titratable Acidity (g/L), Firmness (N) and Sensory Characteristics of Pickled Common Bean

Blanching is commonly in hot water within a short period of time which is widely applied before to inactivate deleterious enzymes and to destroy various microorganisms present in fresh green vegetables [13].

In our current research, common bean was blanched in hot water in different condition (100^{o}C in 4 seconds; 95^{o}C in 6 seconds; 90^{o}C in 8 seconds and 85^{o}C in 10 seconds). Our results were elaborated in table 1. It's clearly realized that 95^{o}C in 6 seconds was suitable for blanching of common bean. In another report, baby cucumber was blanched at 95^{o}C in 10 seconds ready for fermentation [10].

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Table 1: Effect of blanching temperature and time to titratable acidity (g/L), firmness (N) and sensory characteristics of pickled common bean

Blanching temperature, time	100°C, 4s	95°C, 6s	90°C, 8s	85°C, 10s
Titratable acidity (g/L)	0.31±0.02^{b}	0.38±0.01^{a}	0.36±0.03^{ab}	0.33±0.02^{ab}
Firmness (N)	1.29±0.00^{c}	3.05±0.00^{a}	2.84±0.01^{ab}	2.53±0.00^{b}
Sensory score	2.28±0.03^{c}	2.74±0.02^{a}	2.42±0.02^{ab}	2.19±0.0^{b}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Effect of Calcium Chloride Concentration in Soaking to titratable Acidity (g/L), Firmness (N) and Sensory Characteristics of Pickled Common Bean

Texture is an important attribute in pickled products. At any type, they must be firm and crisp in order to achieve most consumer acceptance. To assist with maintenance of textural quality, calcium chloride is commonly added in fermentation brines [14]. In our current research, common bean was blanched at 95°C in 6 seconds in hot water. After blanching, it was soaked in calcium chloride by different concentration (0.1%, 0.15%, 0.20%, 0.25%) in 4 hours. Our results were shown in Table 2. The optimal calcium chloride concentration for soaking was recorded at 0.2% for soaking of common bean.

Table 2: Effect of calcium chloride concentration in soaking to titratable acidity (g/L), firmness (N) and sensory characteristics of pickled common bean

Calcium chloride	0.10%	0.15%	0.20%	0.25%
Titratable acidity (g/L)	0.38±0.01^{a}	0.38±0.02	0.38±0.03^{a}	0.38±0.02^{a}
Firmness (N)	3.05±0.00^{c}	3.85±0.03^{b}	3.91±0.02^{ab}	3.94±0.00^{a}
Sensory score	2.74±0.02^{b}	2.88±0.00^{ab}	2.94±0.01^{a}	2.96±0.03^{a}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Effect of Salt: Sugar Ratio in Fermentation to titratable Acidity (g/L), Firmness (N), Total Phenolic Content (mg GAE/g) and Sensory Characteristics of Pickled Common Bean

Lactic acid fermentation of vegetables has an industrial significance only for cucumbers, cabbage and olives [15]. In our present study, different salt: sugar mixture (6.5%, 3.5%, 7.0%:3.0%; 7.5%:2.5%; 8.0%:2.0%) were examined. Our results were noted in Table 3. The optimal salt: sugar was noticed at 7.5%:2.5%. Cucumber fermentations with and without NaCl in the fermentation brine were similar both in the chemical changes caused by the fermentative microorganisms and in the retention of firmness in the fermented cucumbers [16]. In another research, baby cucumber was fermented with 7.0% salt without sugar for fermentation [10].

Table 3: Effect of salt: sugar ratio in fermentation to titratable acidity (g/L), firmness (N), total phenolic content (mg GAE/g) and sensory characteristics of pickled common bean

Salt%:sugar%	6.5%:3.5%	7.0%:3.0%	7.5%2.5%	8.0%:2.0%
Titratable acidity (g/L)	0.38±0.03^{a}	0.37±0.02^{ab}	0.35±0.03^{ab}	0.31±0.02^{b}
Firmness (N)	3.91±0.02^{b}	3.95±0.03^{ab}	4.13±0.01^{a}	4.15±0.02^{a}
Total phenolic (mg GAE/g)	13.58±0.04^{c}	14.22±0.00^{b}	15.17±0.04^{a}	14.51±0.01^{ab}
Sensory score	2.94±0.03^{c}	3.14±0.00^{b}	3.76±0.03^{a}	3.53±0.01^{ab}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Pickled products by lactic acid fermentation have unique flavor and great healthful effects. Vegetable can be preserved by fermentation, direct acidification or a combination of these along with other processing conditions and additives to yield products that are referred as pickles [17, 18]. Pickling process is relatively a good method for the preservation of phenolic acids in vegetables [11].

Conclusion

Common bean has a great potential and great demand in international market mainly because of its freshness, taste, nutrition and its multiuse.

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The consumption of lactic acid fermented vegetables helps enhance balanced human nutrition. Lactic acid fermentation retains all the natural plant ingredients while improving the quality, taste and aroma. The benefits of pickled common bean have been better understood in terms of high protein, important minerals, dietary fiber and some vitamins, so consumption has also increased in recent years. It becomes a significant source of important nutritional components for food security and a healthy food supply.

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